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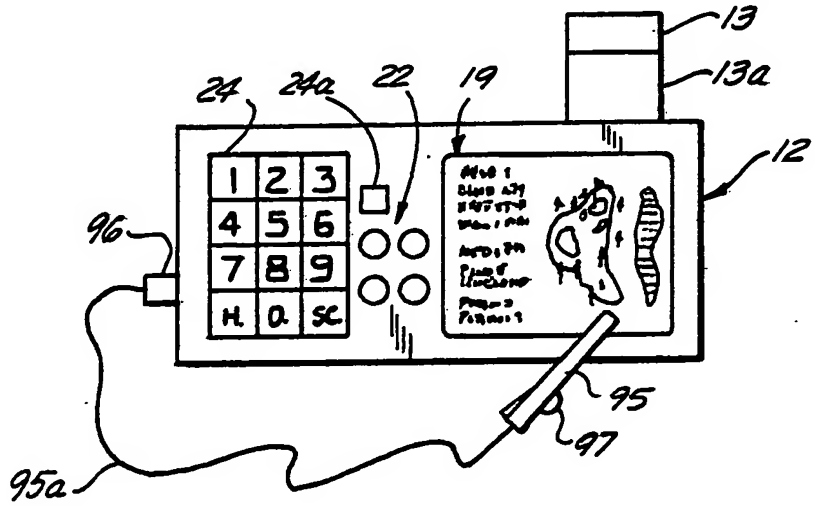

(57) Abstract

A golf cart computer (12) for installation in a golf cart (10). The computer (12) contains a display screen (19) for showing graphically the details and features of each hole of a golf course. It has a memory (40) for containing the graphic details of the course and for containing scores of each player. The computer (12) has a keyboard (24) for entering scores and players; bets and othe r information. In a preferred embodiment, the computer (12) has a communications link (15) for communicating via infra-red light with a stationary printing station (17) and produces a printout of the accumulated scores. In one version of the invention, a light pen (95) is connected to the computer (12) for marking the location of the golf ball on the display screen (19), and the computer (12) is capable of computing and displaying distances between selected features of the golf course and the ball.

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GOLF CART COMPUTER

FIELD OF THE INVENTION

The invention relates to golf cart computers, and more particularly, to a computer attached to a golf cart for keeping scores and for displaying graphics and data relating to the golf course, and for producing a score card for each player.

BACKGROUND

Golf players playing on a course consisting of a typically nine or eighteen holes, in the course of playing a hole, often would like to know details in regard to distances between various features of the course and their mutual location. In particular, features such as sand traps, trees, water holes, and slope of the terrain are desirable, in order to be able to play a better game.

Inventors have in the past sought ways to help golf players improve their score.

U.S. Patent No. 3,898,437 shows a golf cart with a built-in yardage indicator to show the player the approximate distance travelled from the tee-off point.

U.S. Patent No. 4,367,526 shows a hand-held golf calculator on which a player can keep scores and which may contain data on the course, the players and contest arrangements.

U.S. Patent No. 4,419,655 shows a display device which contains pictorial presentations of each hole with electric indicators showing special features that are of interest to the players.

The inventor of the instant invention believes that

none of the prior art provides a golf player with an adequate diversity of information that would be desirable under many different playing conditions.

It is therefore an object of the present invention to provide a golf cart computer that provides a wide range of information for a golf player during the game.

It is a further object to provide a golf cart computer that has a keyboard and memory on which each player in a team can keep his scores for each hole and a display screen on which he can recall scores from previously played holes.

Further, it is an object to provide a golf cart computer that has stored in memory, data and distances and locations of various features of the course such as location of traps, water holes, putting green, the hole and so forth, that can be displayed in graphic form on the screen.

It is still another object to provide a golf cart computer that can interact with a printout device located at the end of the course on which the total scores of each player can be summed up and printed out on a score card.

SUMMARY OF THE INVENTION

The golf cart computer according to the teachings of the instant invention comprises a self-contained golf cart computer with a keyboard and a display screen which can be mounted on the cart's dashboard, preferably on the right hand side of the steering wheel. The computer is preferably powered from the golf cart's electric storage batteries with additional back-up power. It contains electronic memory which has stored therein a wide range of information, pictorial presentations, and data which the golf player can display on demand on the screen during the game. In particular, the player can call out pictorial presentations of any hole with sand traps, water, trees, etc. around the hole. Also, distances between the features may be displayed and optionally terrain slopes may be displayed. Also, graphical presentations of the

fairways and location of the obstructions may be displayed.

It is recognized that graphic presentations require a considerable amount of storage memory, that may not be conveniently stored in a small dashboard mounted computer. In order to overcome this problem, the instant invention teaches a method for economically storing the graphics presentations by means of a catalog of symbols such as trees, traps, greens, etc. in vector graphic form that can be called from the catalog and displayed with proper coordinates and orientations on the screen. By that means, a common catalog of symbols can be used for many holes and considerable memory size can be saved.

The computer also contains memory locations for containing each player's score for each hole and the players can, on demand, recall the scores for previously played holes, and at the end of the game, the computer may compute each player's total score, and include handicaps and other information as desired.

In an especially advantageous embodiment of the invention, the player, when returning to the clubhouse, may stop at a printout location where a stationary apparatus with a printer in communication with the golf cart computer via in infra-red communications channel receives the scores and prints out a score card for each player and, if desired, his standing and/or handicaps.

Further objects and advantages of this invention will be apparent from the following detailed description of a presently preferred embodiment which is illustrated schematically in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a golf cart with a dashboard mounted computer adjacent the printout station, and an infra-red connection;

Figure 2 shows the face of the golf cart computer with a graphic display of a hole on the display screen and a keyboard and an infra-red transmitter-receiver;

Figure 3 shows a more detailed view of the display

screen showing a fairway with a hole surrounded by traps and trees;

Figure 4 shows a schematic block diagram of the golf cart computer with the major function blocks and their mutual connections;

Figure 5 shows a schematic block diagram of the printing station's computer with the major function blocks and their mutual connections;

Figure 6 is a diagram of the major software modules of the control program of the golf cart computer;

Figure 7 is a flow chart of the major steps in the operation of the golf cart computer and its interaction with the printing computer;

Figure 8 is an all alpha-numeric display of data for two fairways;

Figure 9 is an enlarged view of a combined graphic display of a fairway with putting green and an alpha-numeric display;

Figure 10 shows typical examples of graphic presentations of golf course features on a picture screen;

Figure 11a shows a typical data table of coordinates for graphic presentation in polar coordinates;

Figure 11b shows a typical data table of coordinates for graphic presentation in cartesian coordinates;

Figure 12 is a power supply for the printing station;

Figure 13 is a schematic circuit diagram of the phase lock loop and the serial driver for the light emitting diode;

Figure 14 is a schematic circuit diagram of the infrared diode receiver; and

Figure 15 is an enlarged view of a keyboard with command keys and digit keys.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Before explaining the disclosed embodiments of the present invention in detail it is to be understood that the invention is not limited in its application to the details of the particular arrangements shown since the invention is capable of other embodiments. Also, the terminology

used herein is for the purpose of description and not of limitation.

Figure 1 is an illustration showing generally a golf cart 10 having a golf cart computer 12 installed on the dashboard of the golf cart. The computer 12 is connected to an infra-red transmitting diode 13 mounted on a small pedestal 13a at a convenient location on the golf cart from where the golf cart computer 12 can communicate via an infra-red communications channel 15 with a fixed printer station 11, consisting of a printer 16 for printing a score card under control of the golf cart computer 12. The printer station 11 also contains electronic printer control apparatus that is connected to the infra-red receiver 18. The printing station 11 is advantageously installed in a housing mounted on a pedestal 14 and conveniently located where the golfers return with the golf carts after a game.

Figure 2 is a view of the face of the golf cart computer 12, showing a viewing screen 19, a keyboard 24 and various tuning and adjustment buttons 22 which also include an on-off switch. The viewing screen 19 shows as an example a graphic presentation of a hole shown in more detail in Figure 3, e.g. hole "01" showing sand traps 24, a green 26, a waterhole 25, a flag 27 and a light pen 95, connected by a cord 95a and a plug 96 to the computer 12.

The light pen 95 is an input device used inter-actively with computer screens to identify a certain location on the screen and to mark the point of the location by its coordinates x, y (Figure 10) on the screen. It can be used to point to areas of the screen and thus indicate a selection from a displayed list, or it can be used to draw shapes. The light pen has a photosensor at the tip that responds to the peak illumination that occurs when the CRT scanning spot passes its point of focus. The display system coorelates the timing of the pulse from the photosensor with the timing of the display scan to determine the position of the light pen.

When the light pen is used to draw shapes, the difficulties of parallax - due to thickness of the screen - and the lack of a fine point at the tip of the pen are overcome by use of a tracking cross. The display system generates a fine-line tracking cross and positions it so that its intersection is central in the field of view of the light pen. As the light pen is moved across the screen the tracking cross follows it closely and the path of the intersection point is stored in the display file. A switch 97 - usually on the pen - is used to indicate the intended point of the screen, which is then marked, e.g. with an asterisk which stays at that point of the screen until the screen display is erased. Since the coordinates of the asterisk stay in the computer Video RAM 40, it is accessible to the computer's control program and the computer is capable of computing and displaying the physical distance from the asterisk to any other feature of the golf course, or the particular hole, which is defined in the computer's graphics memory 42.

Figure 3 shows, as an example, a graphic presentation of the details of a section of the golf course that may be of interest to a golfer. In Figure 3 it is assumed that the golf cart is located at the asterisk * at the lower left hand corner of the graphic screen display. A waterhole 25 is shown, as well as the green 26, the flag 27, three sand traps 24, and trees 23. It follows that other graphic information may be presented at the selection of the player such as distances, terrain, slopes and so forth by calling out codes for the desired presentations at the keyboard 21.

The screen display 19 also shows at its left hand side alpha numerical information that is of interest to the players. The information shown covers the hole number (01), the distance to the flag from tee blue, white and red, the hole par value (5), handicap (3) and the cumulative scores for two player A & B, as the scores are being entered during the game. It follows that other alpha numerical in-

formation, as it may be found desirable, may be added to the display.

Figure 4 is a schematic block diagram of the golf cart computer showing the major function blocks of the computer. The heart of the computer is the central processing unit (CPU) 27 which may be any one of many types commercially available. In an operational realization of the invention, a CPU of the type Z-80 manufactured by the Zilog Corporation was used, but the exact choice of the type of CPU used is immaterial to the scope of the invention.

The CPU 27 is driven by a clock pulse generator 28, which is in turn controlled by a crystal 29 of any suitable frequency which may typically be 10,180 MHz. The clock generator 28 generates a number of clock frequencies as required for the operation of the computer.

The CPU communicates with the various function blocks via a computer bus 32 of the latter. A read-only-memory (ROM) 39 contains the control programs that control all functions of the computer. The programs consist, as is conventional, of listings of binary encoded instructions and commands which are read and executed by the CPU one at a time. The construction of such computer programs is a well known art and is described in numerous textbooks such as Microcomputer-Based Design by John B. Peatman published by McGraw Hill.

A random access memory (RAM) 41 stores all transient data such as the players' scores, transient computations by the computer and so forth. A keyboard 24 with a keyboard interface 31 serves to receive commands, data and other inputs from the players during the use of the computer. A graphics memory 42 contains all the graphics data required to present the graphic presentations of the features of the particular golf course. The graphics memory 42 is advantageously organized as a separate detachable memory module with a plug-in connection 45 so that the features of various courses and various classes

features or changes can be stored in the module 42 and can be conveniently inserted into the computer as the need arises.

It should be understood that storing of all the topographical details of a golf course in pictorial form requires a considerable amount of memory capability that it is normally not economically desirable to provide in a small, portable computer. It is, therefore, contemplated that a type of abbreviated graphics which comprises a library of standard pictograms representing various repetitively encountered features of the golf course be stored in the memory. Examples of such standard pictograms may be trees, sand traps and water holes in various forms which can be recalled repeatedly and modified as required.

A special information memory 46 may optionally be provided also as a plug-in module for providing information about the golf course that may vary from time to time, such as the conditions of the fairways, temporary changes and so forth.

At the end of the game, when the player returns the golf cart, he drives past the aforesaid printing station 11. The golf computer uses an infra-red diode (LED) 13 connected via the transmit control (X-MIT CTR) 33 to the computer bus 32. The infra-red diode 13 transmits a beam of infra-red light that is modulated in a suitable code which contains the cumulative scores and any other data recorded during the game for each player on the team. Many types of modulation and codes are available for such communication. The so-called pulse-width modulation, wherein the infra-red diode 13 is pulsed with pulses having a width that depends on the sending of ones or zeroes in the transmitted message, is well known and well suited for the instant application. A communication code that is well suited is the so-called ASCII (American Standard Code for Information Interchange) which is widely used and consists of strings of 8-10 ones or zeroes, which represent every

character of the alphabet. The pulse-width modulation of the infra-red diode 13 is advantageously performed by means of a so-called phase-locked loop, of which several are commercially available, such as the 4046 from Motorola or other manufacturers.

The infra-red diode 13 is a light-emitting diode (LED) of a type that emits infra-red light and is especially well suited for light communication. The control circuits, including the phase-locked loop and the encoding circuit are incorporated in the X-MIT CTR 33. Infra-red communication is conventional and has long been used for point-to-point transmission.

In principle, only a one way communication link from the golf cart computer 12 to the printing station 11 is needed, in order to transmit the cumulative scores, but in the interest of the best possible operation, it is advantageous to provide a two way communication link between the golf-cart computer 12 and the printing station 11, because a two way connection allows the golf cart computer to initiate the connection by sending first a code indicating its presence and expecting a return confirmation code from the printing station indicating that it is ready to receive. If such a confirmation code is not received by the golf cart computer, it may be an indication that the apparatus of the printing station is out of order, and the player may then take other action such as calling maintenance personnel or the like. Accordingly, Figure 3 also shows a receiver control (REC CTR) 48 connected to receiving diode 49 for receiving a confirming response code from the printing station. The REC CTR 48 contains circuits that consist of an amplifier that is responsive to the receiving diode 49 and converts the received signal to a signal that is compatible with the transmission protocol of the computer bus 32.

The display screen 19 is advantageously formed by a cathode ray tube (CRT) 37, of the type well known from TV sets and the like, but it may alternatively be a flat

screen display such as an LCD or plasma display or any other suitable display device. The CRT is controlled by a CRT control circuit (CRT CONTR) 38 which provides the control potentials for steering the electron beam, including horizontal and vertical controls and others as is well known from the art of CRT displays. A video random access memory (VIDEO RAM) 40 stores all the picture elements of the picture presented on the CRT screen. It contains at least as many memory bits as there are picture elements in the picture. A RAM memory containing 256 x 256 bits, and consisting of four (4) 5516 memory chips has been found to work well.

The VIDEO RAM 40 is connected to the computer bus 32 via a display interface (DISPL IF) 36, consisting essentially of a commercially available chip 6845 which interacts with the CPU 27, to enter a new picture from the graphic memory, whenever a new picture is called for. Once a picture is entered into the video memory 40, the memory keeps refreshing the picture on the screen under control of the CRT CONTR 38, until a new picture is entered.

A hardware monitor 81 is a monitor circuit that continuously monitors all the functions of the golf cart computer 12 for proper performance under control of the control program designated function monitor module 79, shown in Figure 6. Such function monitor systems are well known in most computer systems and provide an alarm or other suitable indication to the user of the system. Electric power for the golf cart computer 12 is drawn primarily from the battery (BAT) for the golf cart, but a standby power circuit 30 is provided which contains a separate battery that insures that the information stored in the RAM is not lost in case the golf cart battery should fail.

Figure 5 is a functional block diagram of the printer control apparatus 17 of the printing station 11 of Figure 1.

As stated hereinabove, in principle, the printer control 17 may be arranged as a receive only circuit, but for practical reasons it is advantageous if it can also trans-

mit to the golf cart computer 10 in order to send back verification signals to the golf cart computer. Therefore, a transmitting infra-red LED 20 may be provided, which is connected to the CPU bus 52 via a transmit control (X-MIT CTR) 55. A power supply 68 shown in more detail in Figure 12 draws power e.g. from an ac-main power source and converts it to the potentials needed for the individual circuits of the printing station 17. Again, the circuit may have standby power provision 69.

It contains typically similar function blocks as the golf cart computer 12. It has a CPU 53 connected to a clock generator 54 with a crystal 56. The CPU 53 is the main control element which is responsive to a control program stored in the ROM 61. A RAM 59 contains transient data needed in the execution of the program. An optional keyboard 57 with a keyboard interface (KBD IF) 59 enables a maintenance person to service and trouble shoot the station. A clock calendar (CLOCK CALD'R) 63 maintains proper time and date and enables the CPU 53 to print the proper time and date of every score card. A printer 66 is provided for printing a score card 67 or other information, as may be desired, onto a paper strip 67a, which forms the scorecard when torn off the printer. It is connected to the CPU 53 via the CPU bus 52 and is also controlled by a part of the control program stored in the ROM 61.

An infra-red receiving diode (CR) 18 is connected to the CPU bus 52 through a receive control (REC CTR) 51 which amplifies the output from the diode 18 and converts the serial information from the golf cart computer into a form that matches the bus protocol for the bus 52.

The infra-red receiver 17 in the printing station 11, shown in more detail in the schematic circuit diagram Figure 13, is powered by a power supply shown in more detail in Figure 12, which comprises a 24 volt secondary center-tapped transformer 201 connected to a fullwave bridge rectifier 202. The outputs of the bridge rectifier

202 is coupled into capacitors 203 and regulators 204 and 205 which provide a plus and minus 12 VDC potential for the remote receiver 17, the phase lock loop 206 and serial driver 207.

The details of the receiver control circuit 48, 51 are shown in more detail in Figure 14.

The receive diodes (CR) 49, 18 are highly sensitive infra-red detectors. CR is a wide angle avalanche photo diode operating in reverse bias mode, which is used to detect infra-red light photons at 48 and 68 KHz that are being generated from the photo LEDs located with the printing station's and the golf cart IR transmitter circuits 55 and 33 respectively. The receive controls 48, 51 provide good current gain from the AC coupled CR 49, 18. The receive controls 48, 51 further contain a high pass filter 50 resonating at 37 KHz which is very responsive to frequencies from 30 KHz and above.

A phase lock loop and serial driver circuit shown in Figure 13 is used as an A to D converter using a phase lock loop integrated circuit 4046 (ref. numeral 206) having the center frequency at 48 KHz +/- 10% and the offset frequency at 68 KHz +/- 10%. The result is a digital serial data output from the demodulated output swinging between +4.8V and +1.8VDC.

The serial driver LM 339 is in essence a comparator whose threshold is set by resistors to 5.8 volts. The demodulated output from the infra-red detector is fed to the receive controls 48, 51. The effective output may be an RS-232 EIA standard of serial data transmission.

The printer 66 being used with this invention is advantageously an OKI Data 82A printer which has an 80 character buffer built into the interface. With a baud rate of 300 there is no need for handshaking from the host computer in order to control the printer buffer.

Figure 6 is a functional block diagram of the control program stored in the golf cart computer's ROM 39. In accordance with accepted principles, the control programs

consist of a plurality of program modules that each serve an identifiable function which is part of the total control program. In a typical organization of the control program, a main program module 71 maintains overall control of the entire program and calls into operation every subordinate module whenever needed. The subordinate program modules comprise: a printer control module 85 that controls all functions of the printer and checks that it is functional, e.g. contains paper, has operating power and so forth; a score memory control module 72 that stores each player's scores as they are entered during the game; it may also have provision for storing separate bets between players as may be desired. The actual storing of the numbers takes place in the RAM 41, under control of the score memory control module 72; a display control module 73 for controlling the functions of the display screen, i.e. the CRT 37; a vector graphics generator 74 produces the graphic and feature symbols, and information to be displayed on the CRT 37, and also contains the rules for modifying the symbols to match the actual features of the golf course; a read keyboard module 76 continuously scans the keyboard 24 in order to read manual inputs; an optional cart identity module 77 may be provided in case the cart identity such as the cart number is needed for printout on the score card or for other purposes; a transmit control module 78 operates to organize the format of messages to be transmitted to the printing station as it is stored, for example in the score memory control 72. A function monitor module 79 checks all the elements of the golf cart computer to ensure that all its elements, e.g. the keyboard 24, the power supply 43, the CRT 37, the transmit and receive elements 49, 13 respectively and so forth are operational. It is closely associated with a hardware monitor 81, and any functional disorder detected will be indicated on the CRT 37 or presented on an indicator lamp ALM or the like; a clock calendar module 82 continuously maintains time and date for each transaction

for later printout if desired by the players; a receive control 83 controls receiving of data from the printing station 11; a graphic symbols catalog memory module 84 contains all the basic symbols and characters required by the vector graphics module 74. A light pen module 80 controls the operation of the light pen 95.

It should be understood that the control program may be organized in other ways according to the preferences of the designer of the programs and the details of the tasks to be performed.

Figure 7 is a flow chart program that shows, step-by-step the operation of the golf cart computer and its interaction with the printing station. Some of the steps are optional and may not be used in certain types of operation.

The program begins at Start 100. As the golf cart is checked out from the parking area the maintenance person may perform a check-out in step 101 in which he enters his name or initials at the keyboard 57. The cart may pass a check-out station and identify itself for the record in step 102, and the cart is O.K.'d to leave in step 103. The players are next to identify themselves to the golf cart computer in step 104, in which a start dialogue is presented on the screen which guides the player through the dialogue in which they enter their names, handicaps, side bets and so on, according to established rules.

The computer may present in step 105 some general information to the players, such as special conditions of the course, precautions, special charges and rules and so forth. In step 106, the driver moves to the first or next hole as the case may be. As each hole is played each player punches his score on the keyboard as shown in step 107. The players can, by looking at the screen, see the features of the fairways and greens displayed in relation to his instant position. By placing the tip of the light pen 95 at the point of the screen which represents his position, it will be stored in memory and identified by

its coordinates x & y as described hereinabove. The computer can next, based on the coordinates of the golfer's position and the coordinates of any other feature, determine the distance between those points, and display them on demand, in response to the player entering appropriate codes on the keyboard for calling out those distances and any other related information, so that he can plan his next stroke for the best possible result.

Any such other information than the graphics presentation, which the player may request, are indicated by steps 111 and 112. For each hole played, the sequence consisting of steps 106 through 113 is repeated. The step 113 serves to determine if the last hole has been played. If the answer is yes, the driver goes to the printing station in step 114.

There the golfcart computer establishes communcation with the infra-red receiving apparatus in the printing station and transfers the data thereto, as shown in step 116.

After computing and printing the score, each player tears off his score card from the score card printer 66 in step 117. If there are side bets, each bet is computed on the score card which is torn off in step 118 and the transaction is completed in step 119.

Figure 8 is an example of a display of information which consists entirely of word descriptions of the fairway which may be all a player wants under some circumstances.

Figure 9 is another example of a display which consists of both word descriptions and a simple pictorial presentation of the fairway with the greens, the hole and various traps, and which was described in more detail in connection with Figure 3.

Figure 9 shows as an example a dotted line from the asterisk * to the flag 27, indicating the distance therebetween as 419 yards, which may be displayed in response to a selected command code at the keyboard 24. The terrain

slope may be indicated on demand as shown in the symbol 30b.

Generally stated, there is no limit to the types and amount of information that can be made available to the players using the golf cart computer according to the invention; only the size of the storage memory that is required to produce the pictorial presentations may present a limit.

It is therefore possible to use a special technique for reducing the size of memory required, generally known as vector graphics, which is especially well suited with the present invention.

Figures 10 and 11a and 11b illustrate such an especially suitable method, for the present invention, of vector graphics to save memory. Figure 10 shows examples of pictures on the viewing screen 19 of the CRT 37. A feature 91 may represent the outline of a sand trap, a water hole, a tree or any other feature. The center c of the feature may be indicated by coordinates x1, y1. The end of the vector V rotating an angle alpha about the center c describes the outline 91 of the feature.

The table shown in Figure 11a gives examples of the data required to show the feature 91 in the form of the length of the vector V as a function of the angle alpha, expressed in radians. E.g., at an angle .295 radians, the vector V is equal to 4.93, as the table shows. The table in Figure 11a indicates 64 positions of the vector V; in other words, 64 points on the perimeter of the feature 91. It follows that the perimeter can be indicated by 64 points. It also follows that a simple procedure for interpolating additional points between aforesaid 64 points can readily be devised, in order to present the feature 91 in the form of an almost continuous line. Additional realism can be introduced by means of a procedure for filling the interior of the feature with symbols to indicate water as shown for the feature 92, or leaves in the feature 93 indicating a

tree. Figure 11a also shows the coordinates x1, y1 of the center c in relation to the lower left hand corner of the viewing screen 19. Figure 10 also shows a feature 94 which may be, for example, a boundary line of a fairway which may be presented by points on the line, each represented by cartesian coordinates x2, yx, which may be contained in the graphic memory catalog module 84 in Figure 6. Again a simple interpolation may be used by a computer program to add additional coordinates to supply points between those shown in the table 11b. Using techniques of this type it is possible to show various features of the golf course with a relatively modest amount of computer memory.

Other features of a golf course may also be stored in the graphic memory catalog 84 of Figure 6 which may further contain repetitively used symbols, e.g. the flag, the golf cart and so forth.

Figure 15 shows in more detail the keyboard 24, which consists of ten digit buttons 0-9, two command buttons "HOLE" and "SCORE" which are used to instruct the golf cart computer 12 when a hole is selected or when a score is to be entered. A "PRINT" button 24a instructs the computer 12 to communicate with the printing station 11.

WE CLAIM:

1. Golf cart computer for use on a golf course having a printing station for printing score cards, the computer which comprises:

a central processing unit;

a read only memory for storing control programs;

a graphics memory for storing graphic features of the golf course;

a random access memory for storing transient information;

a keyboard for manually operating the computer;

a display device for displaying the graphic features of the golf course;

a communications link for providing data communication between the golf cart computer and the printing station;

a computer bus interconnecting the central processing unit with the elements of the computer; and

power supply means for supplying power for the computer.

2. Golf cart computer according to claim 1 wherein, said communications link is an infra-red communications link comprising:

an infra-red light receiving diode;

a receive control interposed between the light receiving diode and the central processing unit for coordinating the received data with the printing station.

3. Golf cart computer according to claim 2 further comprising a light pen connected to the computer and a light pen interface circuit interposed between the light pen and the central processing unit for marking the position of the golf ball in the computer's random access memory.

4. Golf cart computer according to claim 1 further comprising a light pen connected to the computer and a light pen interface circuit interposed between the light

pen and the central processing unit for marking the position of the golf ball in the computer's random access memory.

5. Golf cart computer according to claim 4 further comprising means for visually indicating on the display device the marked position of the golf ball.

6. Golf cart computer according to claim 5 wherein, said light pen further comprises a switch for executing the marking of the position of the golf ball in memory.

7. Golf cart computer according to claim 1 wherein, said graphics memory contains data for pictorially presenting the features on the display device.

8. Golf cart computer according to claim 7 wherein, said graphics memory contains the features of the golf course in vector-graphic form.

9. Golf cart computer according to claim 7 wherein, said graphics memory is detachably connected to the computer.

10. Golf cart computer according to claim 1 wherein, said control program comprises:

a main program module for coordinating the operation of the program;

a printer control module for controlling the printer in the printing station;

a score memory control module for controlling the storing of the scores in the random access memory;

a display control module for controlling and coordinating the display device;

a vector graphics module for presenting graphic symbols on the display device;

a read keyboard module; and

a transmit control module for controlling the transmission of data to the printing station.

11. A golf cart computer according to claim 10 further comprising:

a function monitor module; and

a hardware monitor, the function monitor module responsive to the hardware monitor for indicating malfunction of the golf cart computer.

12. A golf cart computer according to claim 10 further comprising a light pen computing module for computing the distance between the golf ball and a designated feature on the golf course.

13. A golf cart computer according to claim 10 further comprising a receive module for providing two-way communication with the printing station.

14. A golf cart computer according to claim 10 further comprising graphic symbols catalog module containing the outlines of the golf course features in vector graphic form.

15. Golf cart computer according to claim 1 wherein, said power supply means further comprises standby power means.

16. Golf cart computer according to claim 1 wherein, said printing station comprises:

a receiving infra-red photo diode for receiving data from the golf cart computer;

printer control apparatus responsive to receiving data from the receiving infra-red photo diode for receiving data from the golf cart computer; and

a printer responsive to said printer control apparatus for printing score cards containing the cumulative scores of the players.

17. Golf cart computer according to claim 16 wherein, said printer control apparatus further comprises a printer control computer having:

a central processing unit;

a keyboard for manually controlling the printer control computer;

a read-only memory for containing printer control

programs;

a random access memory for containing transient data;

a clock calendar with clock calendar interface;

a hardware monitor with an alarm indicator for indicating malfunction of the printing station; and

power supply means.

18. Golf cart computer printing station according to claim 16 further comprising:

standby power supply means for transient data.

19. Golf cart computer printing station according to claim 16, further comprising a housing for containing the printing station, the housing mounted on a pedestal inserted into the ground.

20. Golf cart computer according to claim 1, wherein said display device is a cathode ray tube.

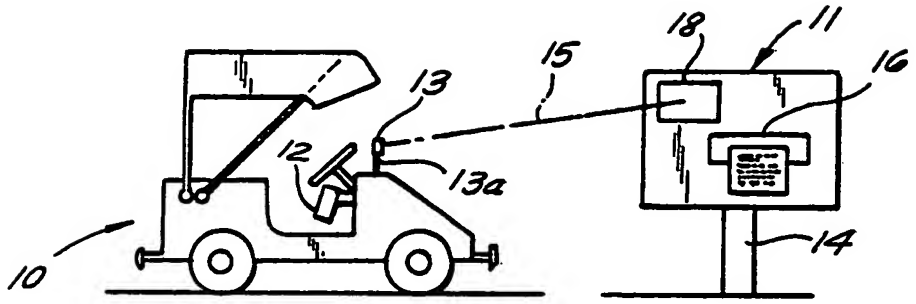
21. Golf cart computer according to claim 20, further comprising:

a display interface for connecting the display device with the central processing unit;

a CRT controller; and

a video random access memory for containing data representing all the picture elements on the display screen.

FIG. 1



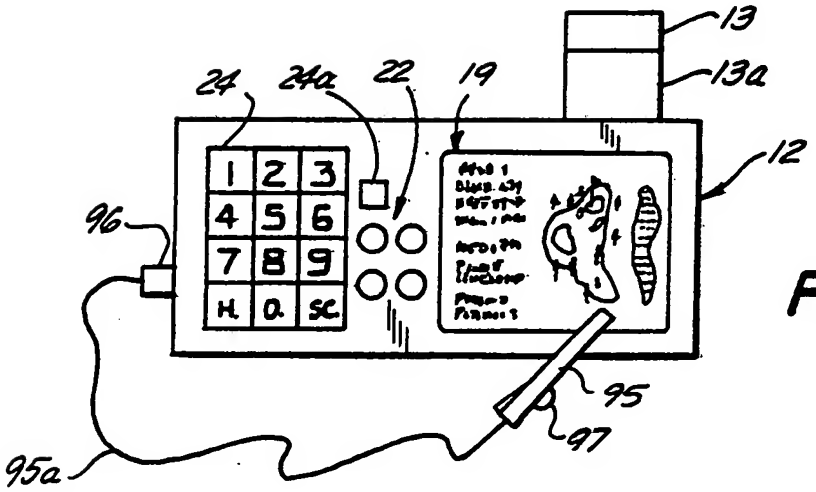


FIG. 2

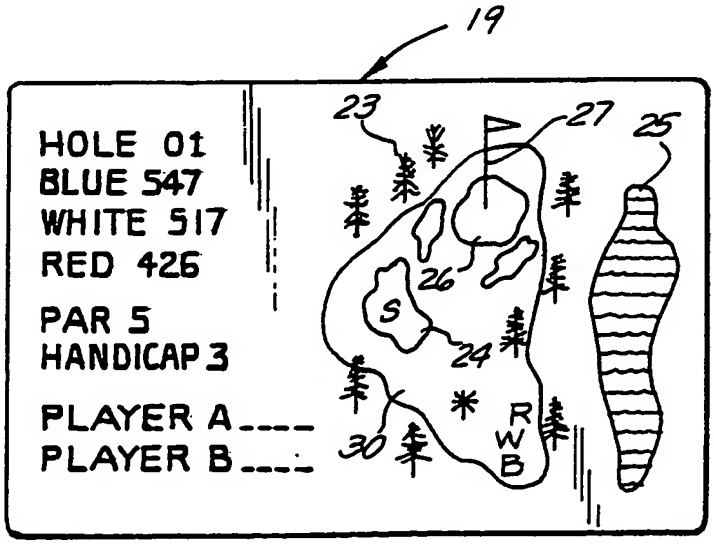
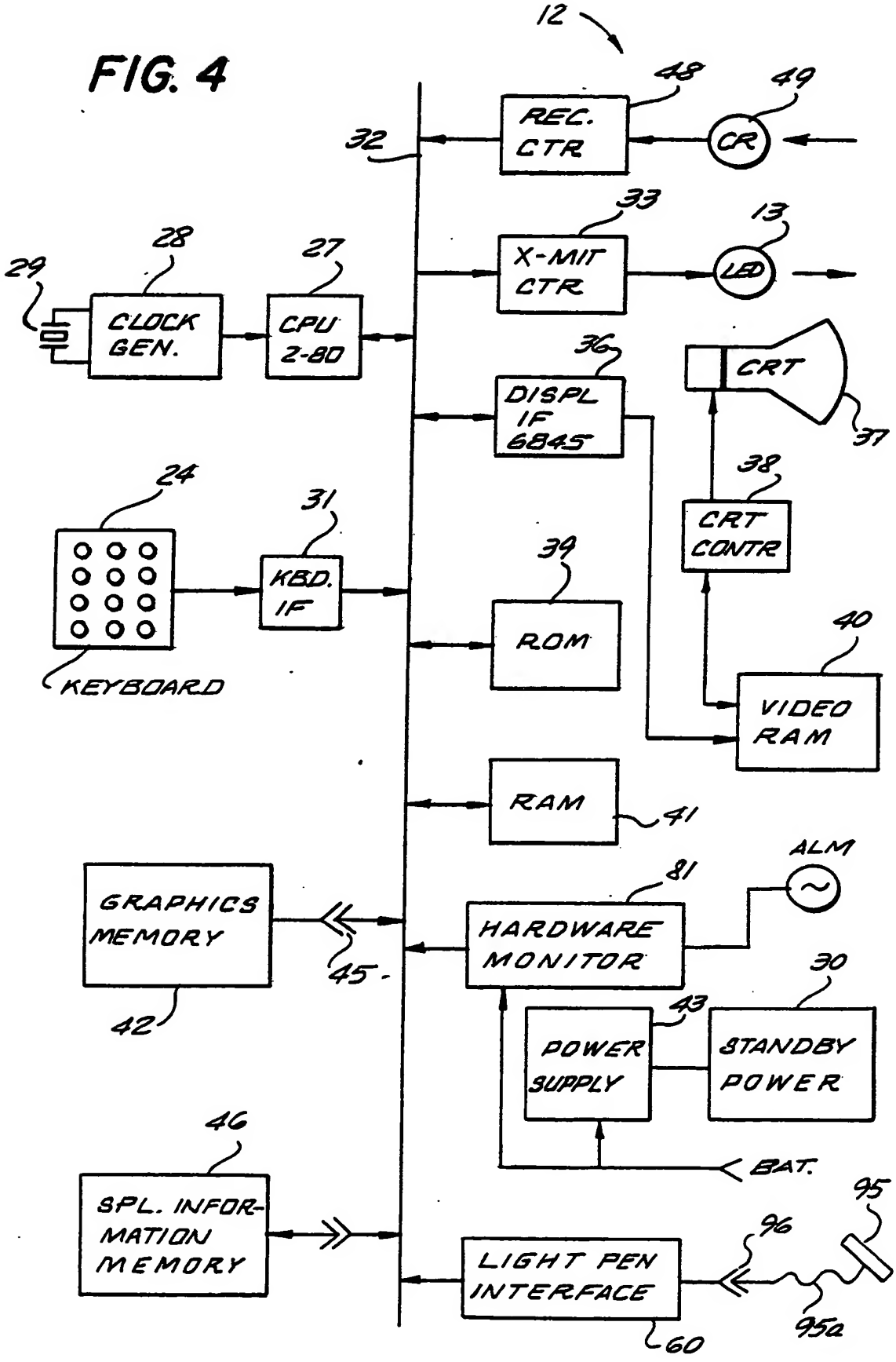


FIG. 3

FIG. 4


12
REC. CTR
48
CR
49
32
X-MIT CTR
33
LED
13
CLOCK GEN.
28
29
CPU Z-80
27
DISPL IF 6845
36
CRT
37
CRT CONTR
38
KBD. IF
31
24
KEYBOARD
ROM
39
VIDEO RAM
40
RAM
41
ALM
GRAPHICS MEMORY
42
45
HARDWARE MONITOR
81
POWER SUPPLY
43
STANDBY POWER
30
BAT.
SPL. INFORMATION MEMORY
46
LIGHT PEN INTERFACE
60
95
96
95a

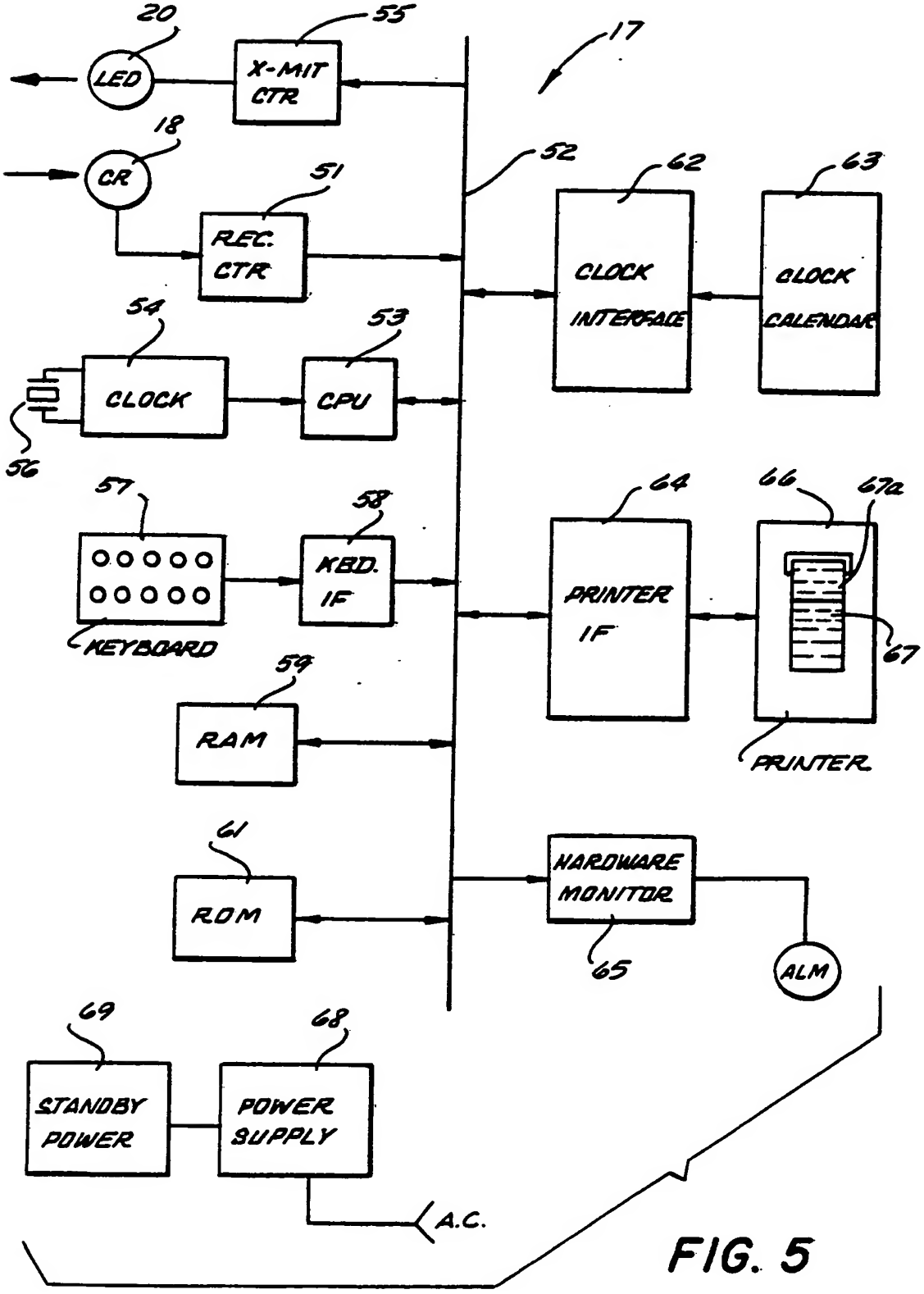

20
55
17
LED
X-MIT CTR
18
52
62
63
CR
51
REC. CTR
CLOCK INTERFACE
CLOCK CALENDAR
54
53
CLOCK
CPU
56
57
64
66
67a
58
KBD. IF
PRINTER IF
KEYBOARD
67
59
PRINTER
RAM
61
HARDWARE MONITOR
ROM
65
ALM
69
68
STANDBY POWER
POWER SUPPLY
A.C.

FIG. 5

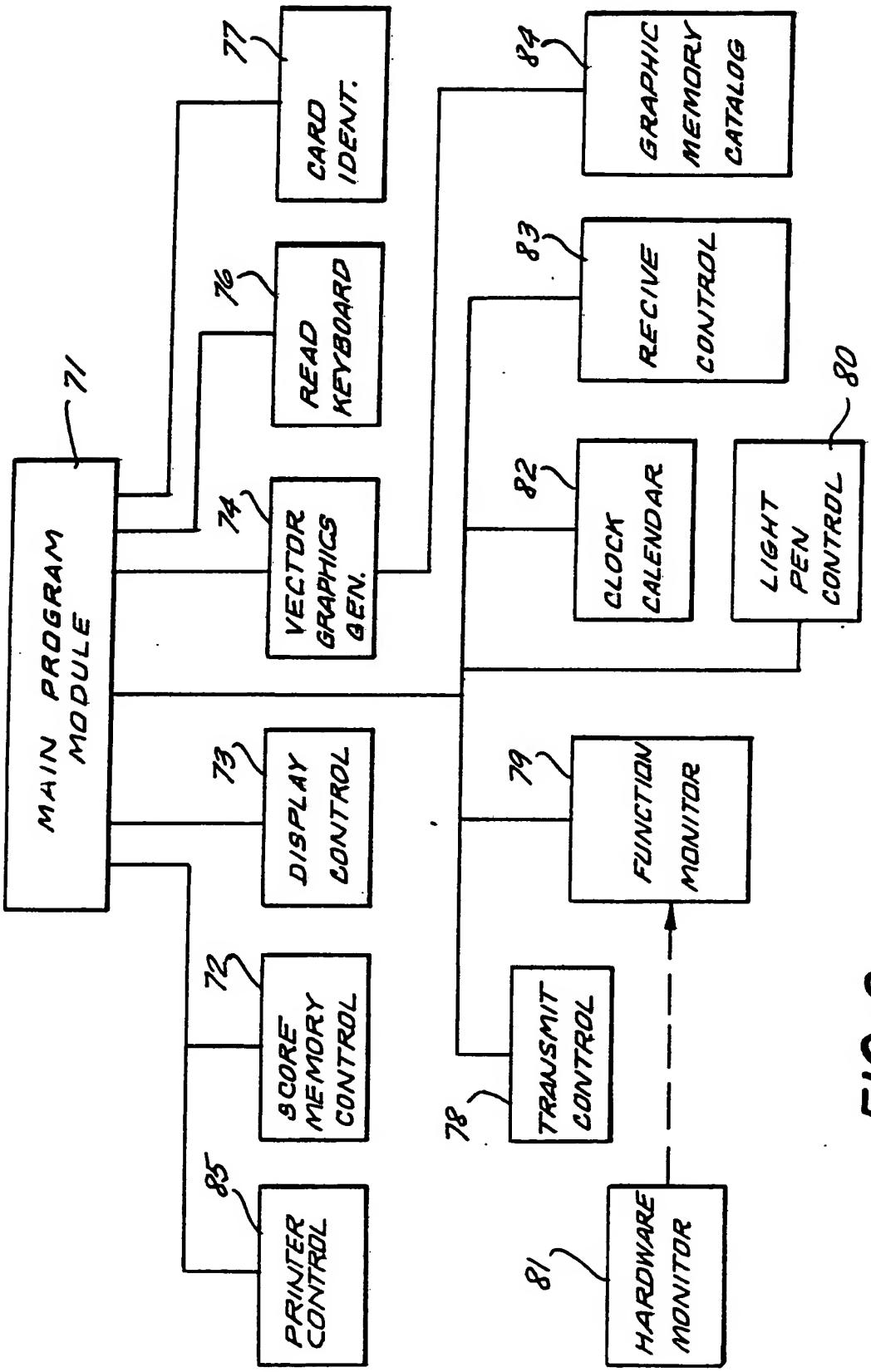

MAIN PROGRAM MODULE
71
CARD IDENT.
77
READ KEYBOARD
76
VECTOR GRAPHICS GEN.
74
DISPLAY CONTROL
73
CORE MEMORY CONTROL
72
PRINTER CONTROL
85
GRAPHIC MEMORY CATALOG
84
RECIVE CONTROL
83
CLOCK CALENDAR
82
LIGHT PEN CONTROL
80
FUNCTION MONITOR
79
TRANSMIT CONTROL
78
HARDWARE MONITOR
81

FIG. 6

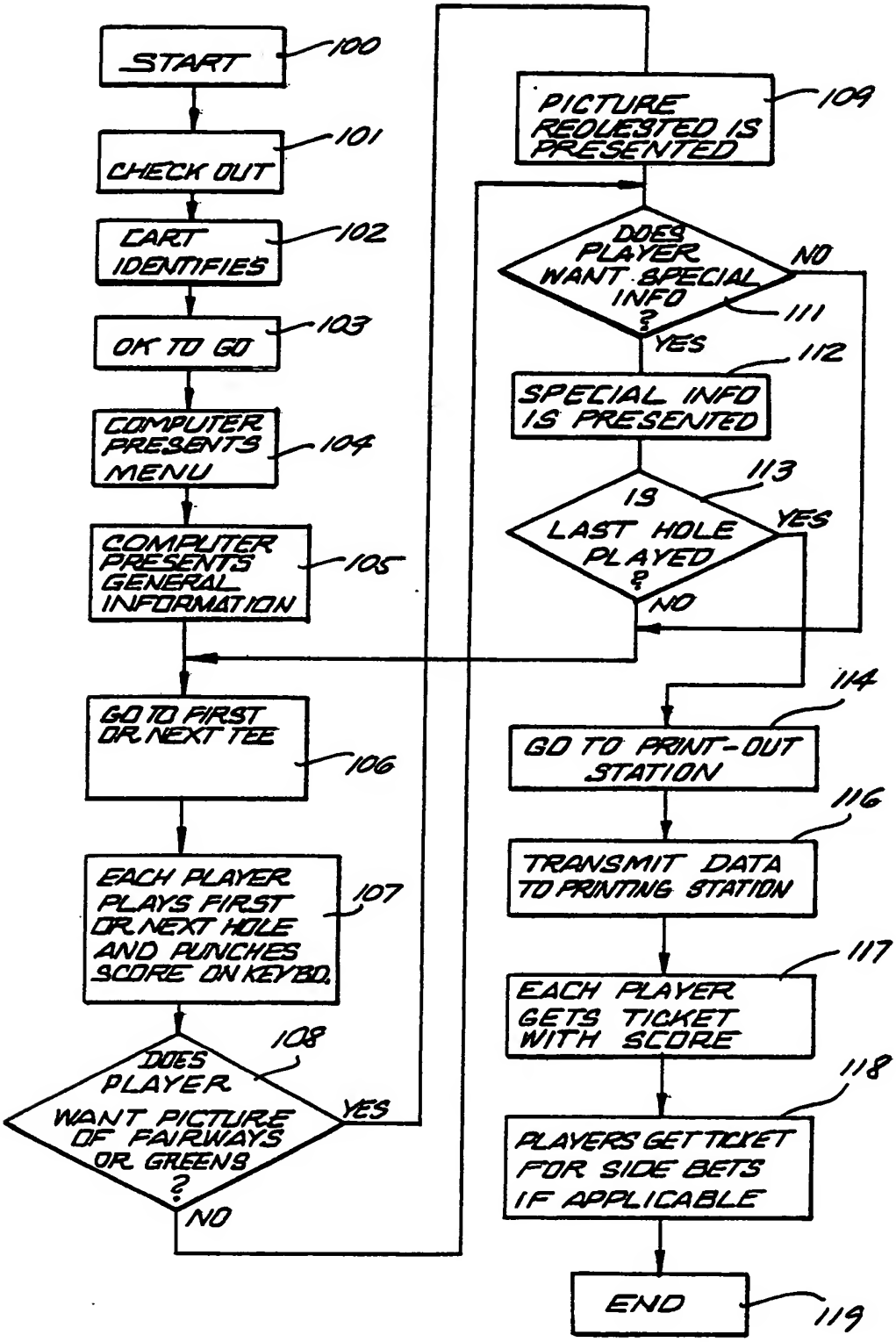

START
100
CHECK OUT
101
CART IDENTIFIES
102
OK TO GO
103
COMPUTER PRESENTS MENU
104
COMPUTER PRESENTS GENERAL INFORMATION
105
GO TO FIRST OR NEXT TEE
106
EACH PLAYER PLAYS FIRST OR NEXT HOLE AND PUNCHES SCORE ON KEYBD.
107
DOES PLAYER WANT PICTURE OF FAIRWAYS OR GREENS ?
108
YES
NO
PICTURE REQUESTED IS PRESENTED
109
DOES PLAYER WANT SPECIAL INFO ?
111
NO
YES
SPECIAL INFO IS PRESENTED
112
IS LAST HOLE PLAYED ?
113
YES
NO
GO TO PRINT-OUT STATION
114
TRANSMIT DATA TO PRINTING STATION
116
EACH PLAYER GETS TICKET WITH SCORE
117
PLAYERS GET TICKET FOR SIDE BETS IF APPLICABLE
118
END
119

FIG. 7

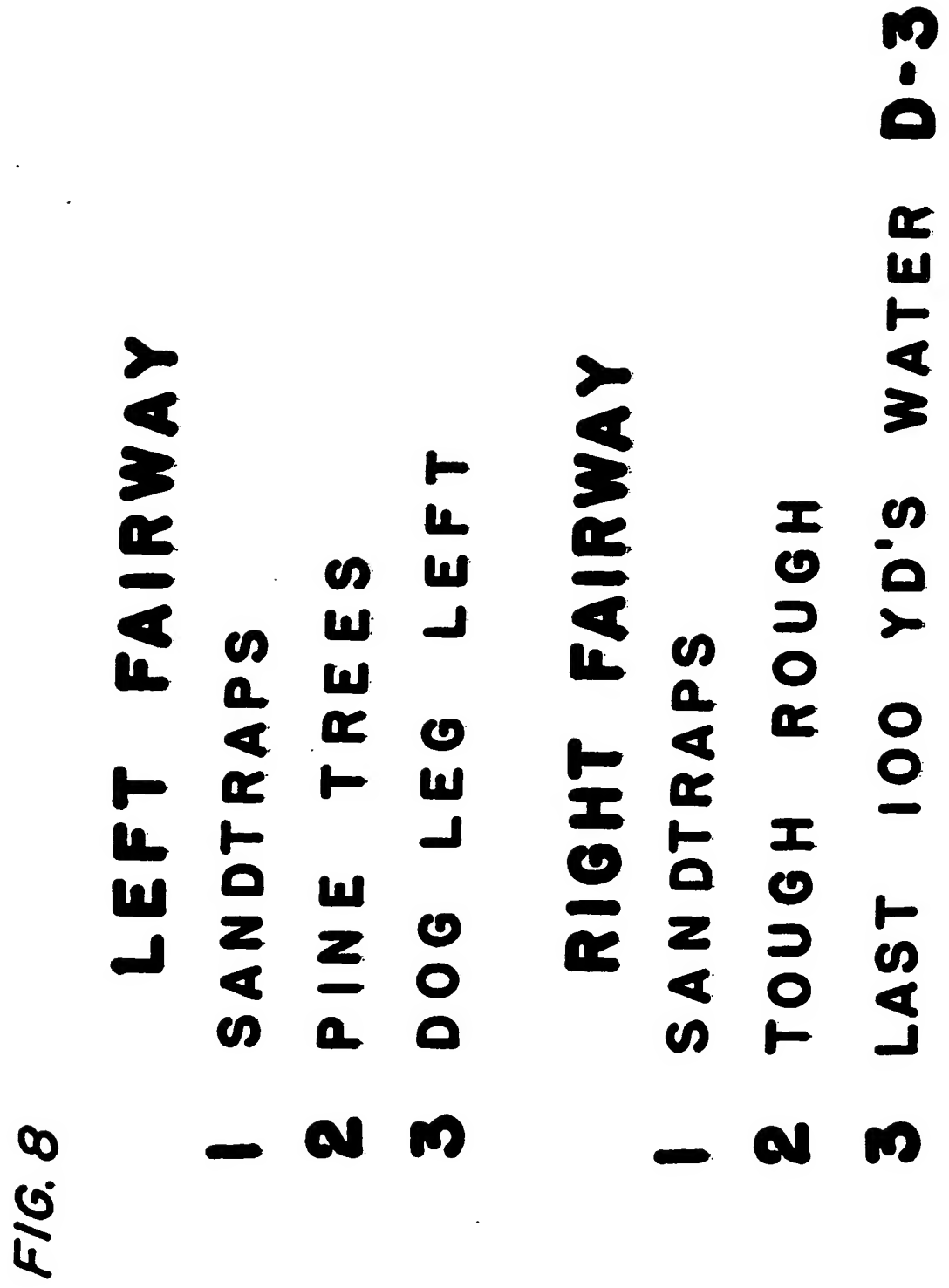

LEFT FAIRWAY
1 SANDTRAPS
2 PINE TREES
3 DOG LEG LEFT
RIGHT FAIRWAY
1 SANDTRAPS
2 TOUGH ROUGH
3 LAST 100 YD'S WATER D-3

FIG. 8

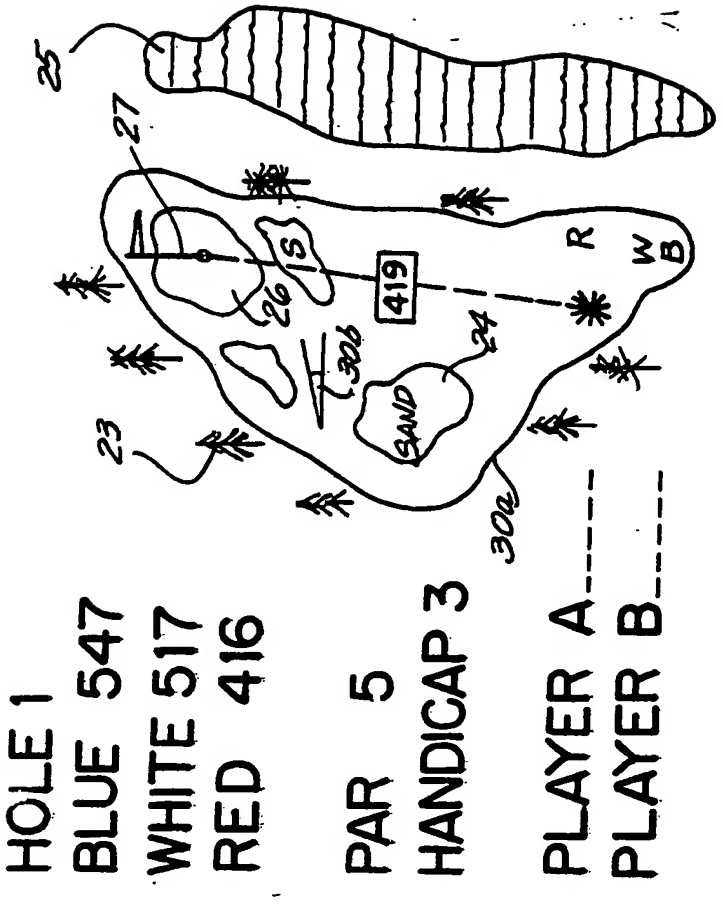

25
27
15
26
419
R
W
B
24
306
23
SAND
30a
HOLE 1
BLUE 547
WHITE 517
RED 416
PAR 5
HANDICAP 3
PLAYER A____
PLAYER B____

FIG. 9

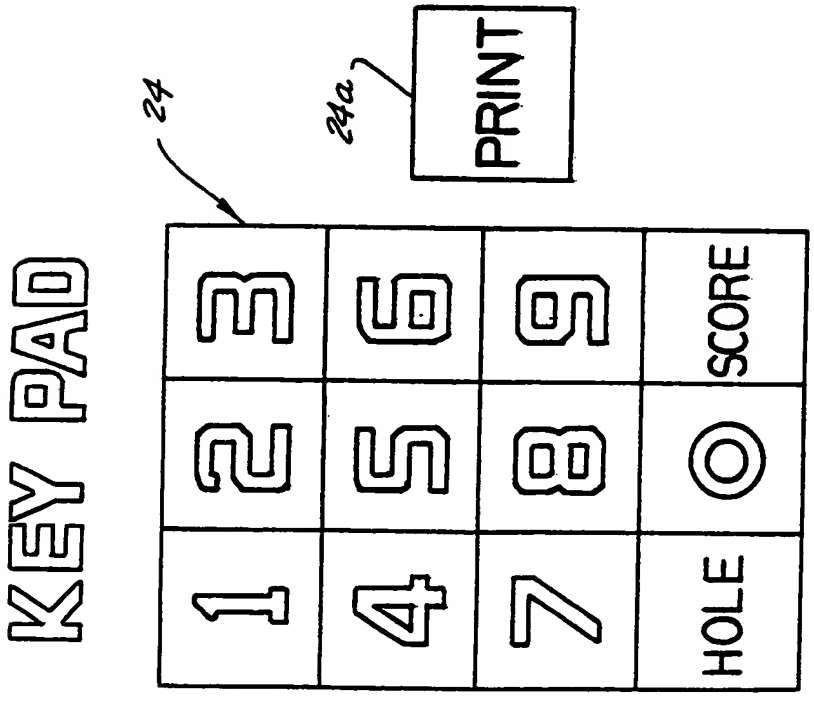

KEY PAD
24
24a
PRINT
1
2
3
4
5
6
7
8
9
HOLE
0
SCORE

FIG. 15

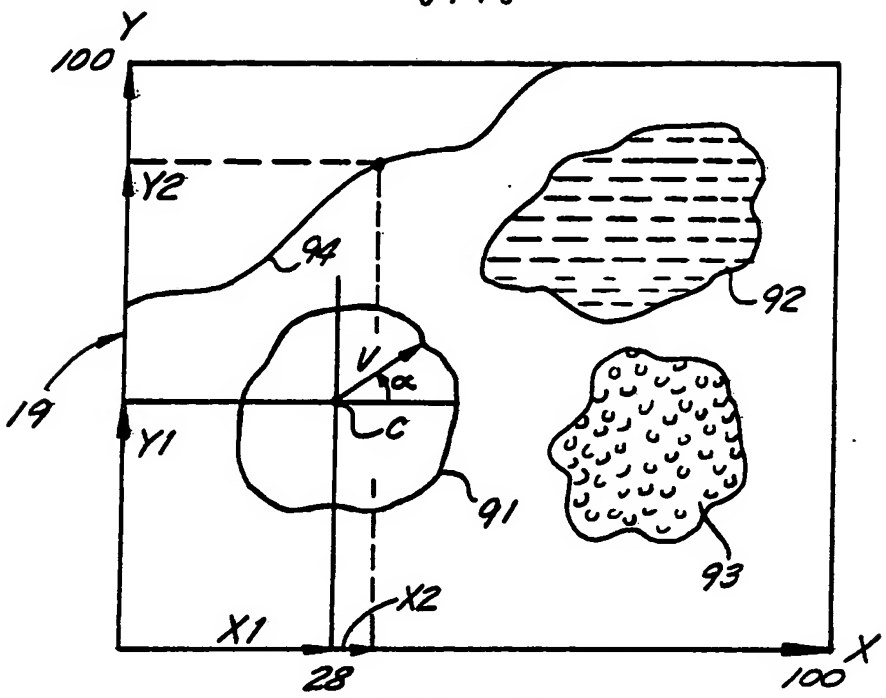


FIG. 10

X1=28	V	4.42	4.56	4.93	4.82		6.41	6.01	5.12	4.41
Y1=31	α	.098	.196	.295	.393		5.989	6.087	6.185	6.283

FIG. 11a

X2	00	01	02			57	58
Y2	85	86	86			100	100

FIG. 11b

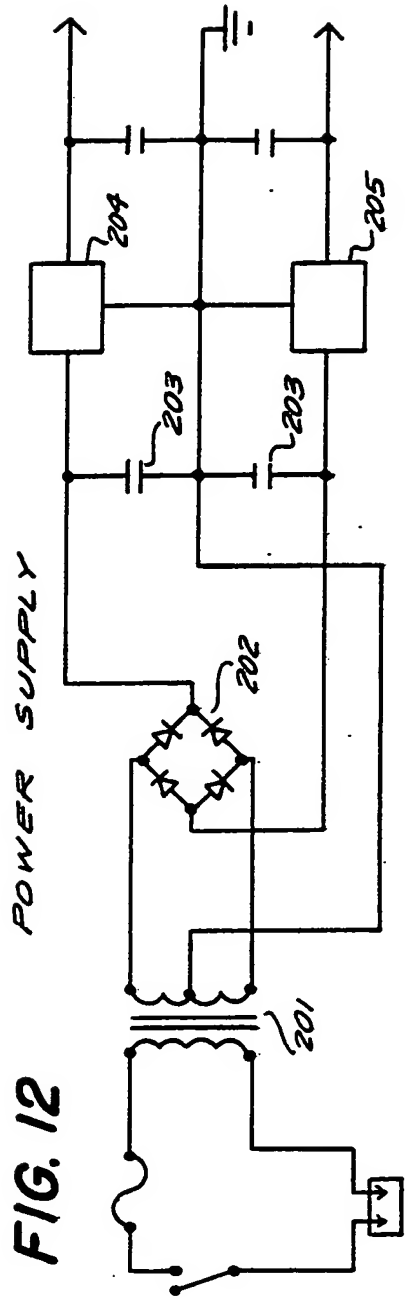

POWER SUPPLY
201
202
203
203
204
205

FIG. 12

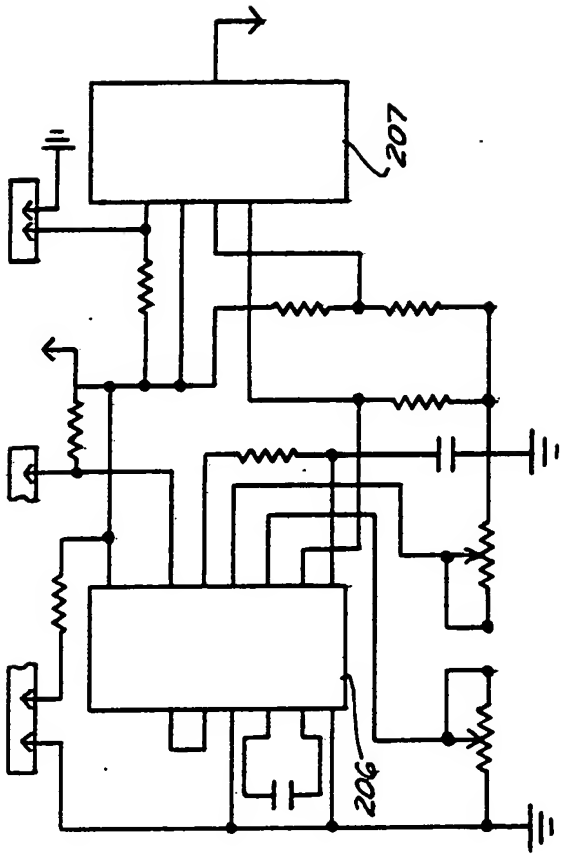

PHASE LOCK LOOP & SERIAL DRIVER
206
207

FIG. 13

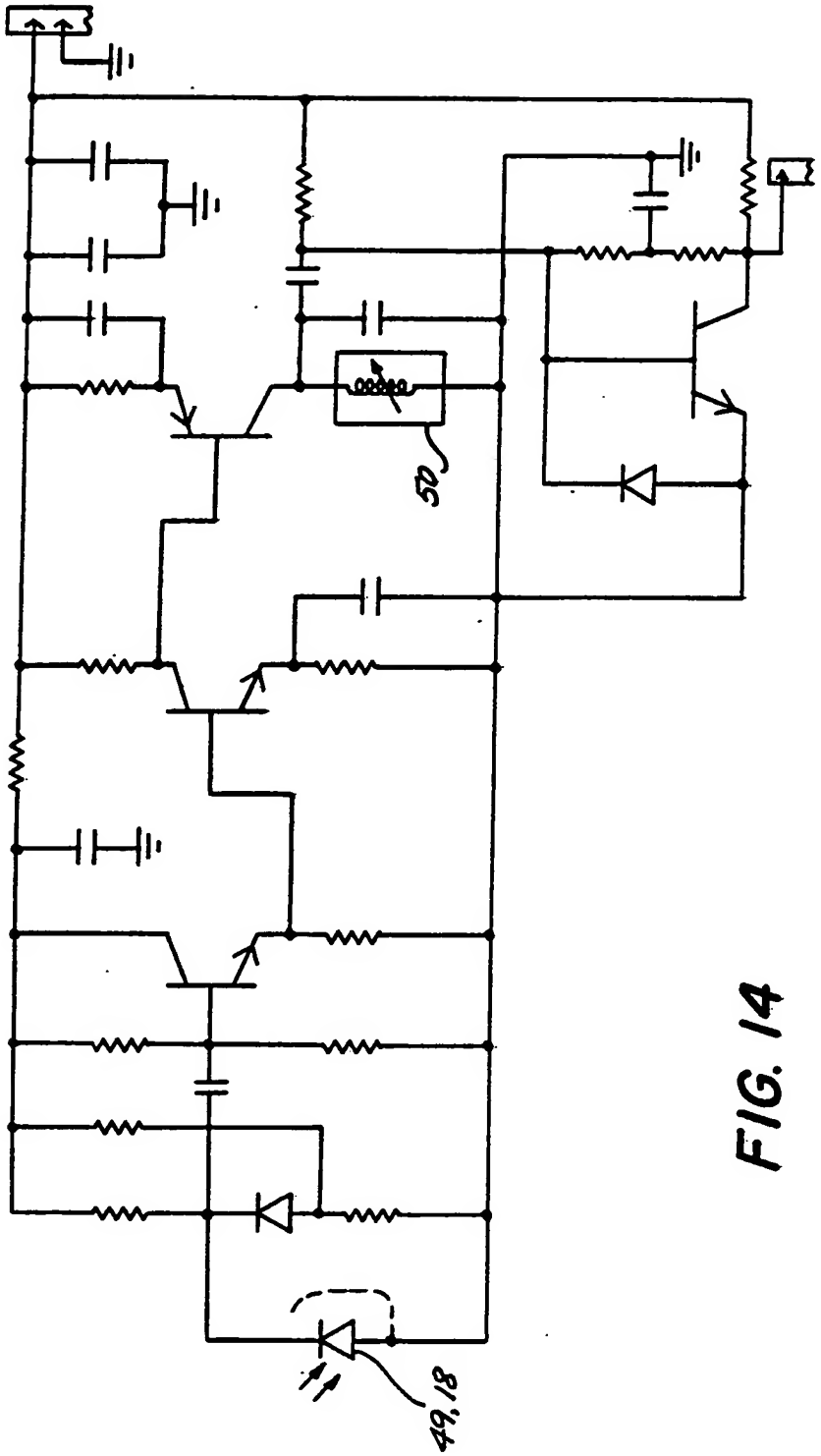


FIG. 14

INTERNATIONAL SEARCH REPORT

International Application No PCT/US86/01501

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC(4) :A63B 67/02, 69/36; G06F 15/20
U.S. Cl. 364/410; 273/185B

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
U.S.	364/410, 412; 273/176L, 185B, 185R

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
Y	US, A, 4367526 (McGeary et al), 4 Jan. 1983, see col. 3, lines 22-25; col. 4, lines 21-40; col 10, lines 45-48.	1
Y	US, A, 4419655 (May), 6 Dec. 1983, see Fig.1, col. 2, lines 20-30; col. 6 lines 10-13.	1, 5, 7
A	US, A, 4086630 (Speiser et al), 25 Apr. 1978, see entire document.	
Y	US, A, 4236152 (Masuzawa et al), 25 Nov. 1980 see Fig(s). 1, 4, 5, col. 22, lines 9-13.	3, 4, 6, 8, 12, 14
Y	US, A, 4365305 (MacDonald et al), 21 Dec. 1982, col. 1; col. 3, lines 1-15.	3, 4, 6, 8,
A	US, A, 4150825 (Wilson), 24 Apr. 1979, see entire document.	

* Special categories of cited documents: [15]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
15 September 1986	22 SEP 1986
International Searching Authority [1]	**Signature of Authorized Officer [20]**
ISA/US	Kim Bui Kim Bui